

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:

Takao KASAI et al.

: EXAMINER J. STEPHENS

SERIAL NO. 09/852,804

:

CONFIRMATION NO. 5485

:

FILED: May 11, 2001

: GROUP ART UNIT: 3761

FOR: ABSORBENT ARTICLE

DECLARATION UNDER 37 C.F.R. § 1.132

COMMISSIONER FOR PATENTS

P. O. Box 1450, Alexandria, VA 22313-1450

RECEIVED

JUN 05 2003

TECHNOLOGY CENTER R3700

SIR:

Now comes Takao Kasai who declares:

That I am one of the applicants of the above-entitled application.

That I have been employed by Kao Corporation for 14 years as a researcher in the field of sanitary products.

That I have read all of the Office Actions in the above-entitled application, and have read and am familiar with each of the references cited in the Office Actions by the Examiner.

That the following experiments were carried out by me or under my direct supervision and control and the results are true and correct to the best of my knowledge.

**EXPERIMENTS****I. Object**

The object of the following experiments is to prove that zinc sulfate heptahydrate as a skin health benefit agent disclosed in the cited reference, US 6,217,890, actually decreases the absorbing performance of a superabsorbent polymer.

**II. Experiments**

### Agents

- zinc sulfate heptahydrate available from Wako Pure Chemical Industries, Ltd., Osaka, Japan
- physiological saline available from Otsuka Pharmaceutical Co., Ltd., Tokyo, Japan
- superabsorbent polymer [cross-linked poly(sodium acrylate)] available from Kao Corporation, Tokyo, Japan

### Method

#### (1) Tea-bag method

Zinc sulfate heptahydrate is dissolved in physiological saline to obtain test solutions of various concentration. One gram of the superabsorbent polymer is put in a nylon mesh bag having a mesh size of #250. Then the bag is immersed into the test solution of 150 ml to make the superabsorbent polymer swell. After 30 minutes, the bag is taken out from the test solution, and put in a desiccator to drain the excess amount of the test solution. Thereafter, the overall weight, i.e., the total weight of the superabsorbent polymer, the bag and the test solution which is held between the superabsorbent polymer particles and absorbed in the superabsorbent polymer particles is weighed to calculate the absorbent capacity (g/g) of tea-bag method. The absorbent capacity of tea-bag method is defined and calculated according to formula (1).

Absorbent Capacity (g/g) of tea-bag method =  

$$\frac{[\text{Overall Weight} - \text{Weight of the Bag} - \text{Weight of the Polymer}]}{\text{Weight of the Polymer}} \quad (1)$$
 wherein Weight of the Bag and Weight of the Polymer are measured in a dried state.

#### (2) Centrifugal method

Next, the bag and its contents are dehydrated in a centrifugal separator at 143G (800rpm) for 10 minutes to remove the test solution held between the superabsorbent polymer particles. Then, the overall weight after centrifugation, i.e., the total weight of the superabsorbent polymer, the bag and the test solution which is absorbed in the superabsorbent polymer particles is weighed to calculate the absorbent capacity (g/g) after centrifugation. The absorbent capacity after centrifugation is defined and calculated according to formula (2).

Absorbent Capacity (g/g) after centrifugation =  

$$\frac{[\text{Overall Weight after Centrifugation} - \text{Weight of the Bag} - \text{Weight of the Polymer}]}{\text{Weight of the Polymer}} \quad (2)$$
 wherein Weight of the Bag and Weight of the Polymer are measured in a dried state.

## Results

The relationship between the concentration of zinc sulfate and the saturation absorption, and the concentration of zinc sulfate and the holding power is shown in Figure 1 below.

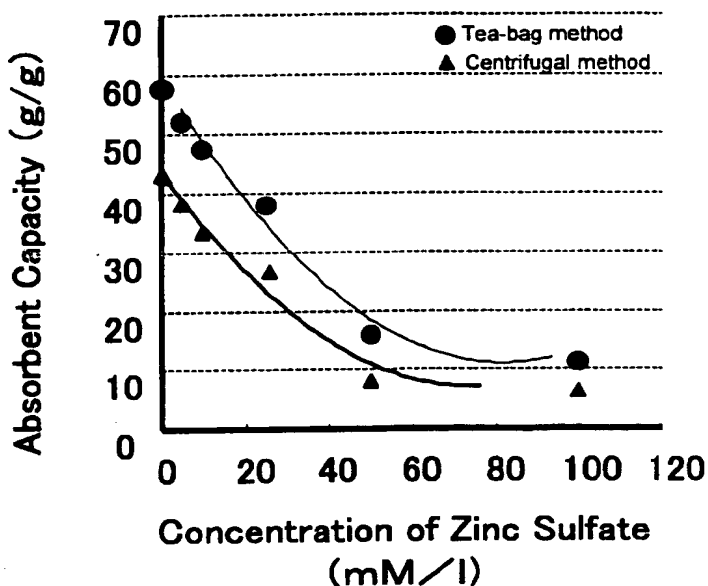


Figure 1

## III. Discussion

As can be seen from the results shown in Figure 1, both the absorbent capacity of tea-bag method and the absorbent capacity after centrifugation decrease in accordance with the increase of the zinc sulfate concentration. These phenomena can be explained by the following reasons. The absorption ability of a superabsorbent polymer is theoretically explained by *ionic network theory* proposed by P. J. Flory. According to this theory, the major factors providing the superabsorbent polymer with the absorption ability are (i) affinity of the polymer for water and (ii) osmotic pressure due to the higher concentration of mobile ions present within the polymer than that of mobile ions dissolved in the solution. On the other hand, the major factor suppressing the absorption ability is the elasticity of the polymer due to its cross-linked network structure. The absorption ability  $Q$  is governed by the balance of these factors, and can be represented by the following equation.

$$Q^{5/3} = \left\{ \left( \frac{1}{2} \times \frac{i}{V_u} \times \frac{1}{S^{1/2}} \right)^2 + \left( \frac{1}{2} - X_1 \right) / V_1 \right\} \times V_0 / v$$

wherein  $i/V_u$  represents the concentration of the charge fixed at

the cross-linked network of the polymer,  $1/S^{1/2}$  represents the ionic strength of the electrolyte dissolved in the solution,  $(1/2 - X_1) / V_1$  represents the affinity of the cross-linked network for water, and  $V_0/v$  represents the density of cross-linked site in the polymer.

In the above equation, the dominant term affecting the absorption ability  $Q$  is  $1/S^{1/2}$ , i.e., the ionic strength of the electrolyte dissolved in the solution. As is apparent from the above equation, the higher the ionic strength of the electrolyte, the lower the absorption ability of the polymer. Zinc ion of zinc sulfate is divalent. Accordingly, zinc ion has the ionic strength twice as much as monovalent ions if the concentration of zinc ion equals to that of monovalent ions. As a result, the osmotic pressure of zinc ion is half of that of monovalent ions. This is why zinc sulfate decreases the absorbing performance of the superabsorbent polymer.

#### IV. Conclusion

As one can see from the above discussion, it is evident that zinc sulfate decreases the absorbing performance of the superabsorbent polymer.

I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date 5.23.2003

Takako Kasai  
Takako KASAI